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Marine protected area network planning in the Western Arctic Bioregion: Identification of a conservation objective and priority conservation areas as required planning components

R. Hodgson, K. Martin, and H. Melling

Fisheries and Oceans Canada
Freshwater Institute
501 University Crescent
Winnipeg MB R3T 2N6
Canada

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

To meet Canada's obligations to the United Nations (UN) Convention on Biological Diversity (CBD), creation of a Marine Protected Areas Network (MPAN) following UN stipulated steps is required. This paper details the completion of step three from the UN CBD, which calls for a process to identify priority conservation areas as planning inputs to the MPAN. Step one was creation of Ecologically or Biologically Significant Areas (EBSAs), step two was to determine ecological units (eco-units) based on a biophysical classification system, and that step three will draw upon step one (biological focus) and step two (physical/habitat focus) to produce a set of potential MPAN sites or Priority Conservation Areas (PCAs). Fisheries and Oceans Canada (DFO) is undertaking this task for the 13 Canadian marine biogeographic areas or bioregions. This paper details the approach taken to delineate PCAs within the Western Arctic Bioregion. Twenty three (23) PCAs were delineated for the bioregion and a conservation objective for the Marine Protected Area Network in this bioregion was established.

Planification du réseau d'aires marines protégées dans la biorégion de l'ouest de l'Arctique : détermination d'un objectif de conservation et des aires de conservation prioritaires en tant qu'éléments de planification nécessaires

RÉSUMÉ

Afin de respecter les obligations du Canada dans le cadre de la Convention sur la diversité biologique (CDB) de l'Organisation des Nations Unies (ONU), il faut créer un réseau d'aires marines protégées (RAMP) selon les étapes prescrites par l'ONU. Le présent document détaille l'achèvement de la troisième étape de la CDB de l'ONU, qui prescrit un processus visant à considérer les aires de conservation prioritaires comme des facteurs de planification du RAMP. La première étape consistait à créer des zones d'importance écologique ou biologique (ZIEB), la deuxième étape consistait à déterminer les unités écologiques selon un système de classification biophysique, et la troisième étape doit s'appuyer sur l'étape 1 (accent biologique) et l'étape 2 (accent physique et sur l'habitat) en vue d'établir un ensemble de sites potentiels pour le RAMP ou pour former des aires de conservation prioritaires (ACP). Pêches et Océans Canada (MPO) a entrepris cette tâche pour les 13 biorégions ou aires biogéographiques marines canadiennes. Le présent document décrit en détail la méthode utilisée pour délimiter les ACP prioritaires au sein de la biorégion de l'ouest de l'Arctique. Vingt-trois (23) aires de conservation prioritaires ont été délimitées pour la biorégion et un objectif de conservation a été choisi pour le RAMP dans cette biorégion.

BACKGROUND

To address Canada's international commitments under the United Nations (UN) Convention on Biological Diversity (CBD) (United Nations 1992), as well as its domestic obligations under the *Oceans Act* (Government of Canada 1996), Fisheries and Oceans Canada (DFO) is in the process of planning Canada's Marine Protected Area Network (MPAN) along with collaborative efforts by provincial and federal government partners. The scope of this task is large given Canada's coastline is the longest in the world. Planning for the MPAN has been broken down, first by Ocean (Atlantic, Arctic and Pacific) and then by high level biogeographic areas referred to as bioregions (DFO 2009a). DFO's Central and Arctic Region is responsible for five marine bioregions in the Canadian Arctic of the 13 total Canadian marine bioregions. The Western Arctic Bioregion (WAB) is the focus of initial efforts to plan the Arctic portion of Canada's MPAN (See Figure 1). Place names within this bioregion are identified in the Appendix. Hodgson et al. (2015) divided the WAB into eco-units (Figure 2) in accordance with MPAN planning protocols set out by the UN and Canada (UNEP 2008, DFO 2009b).

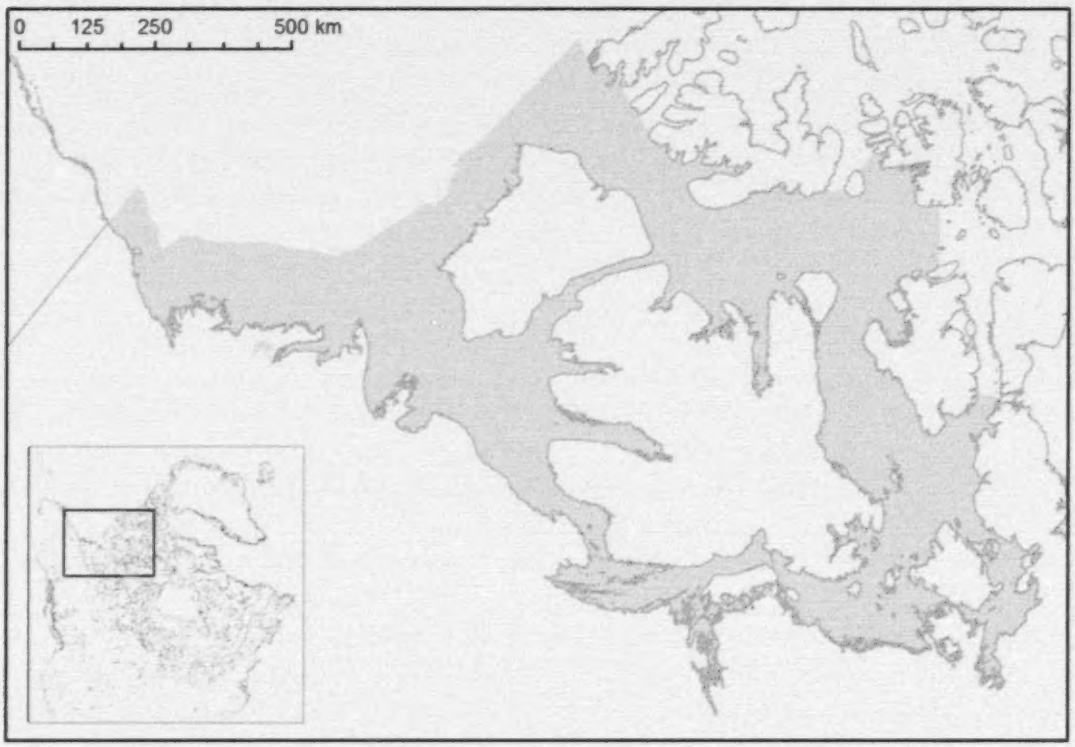

Figure 1. The Western Arctic Bioregion delineated by the blue shading (from DFO 2009a). This bioregion is bounded on the west by the Arctic Basin Bioregion, the boundary between generally following the 200 m depth contour. It is bounded to the north and east by the Arctic Archipelago and Eastern Arctic bioregions, respectively.

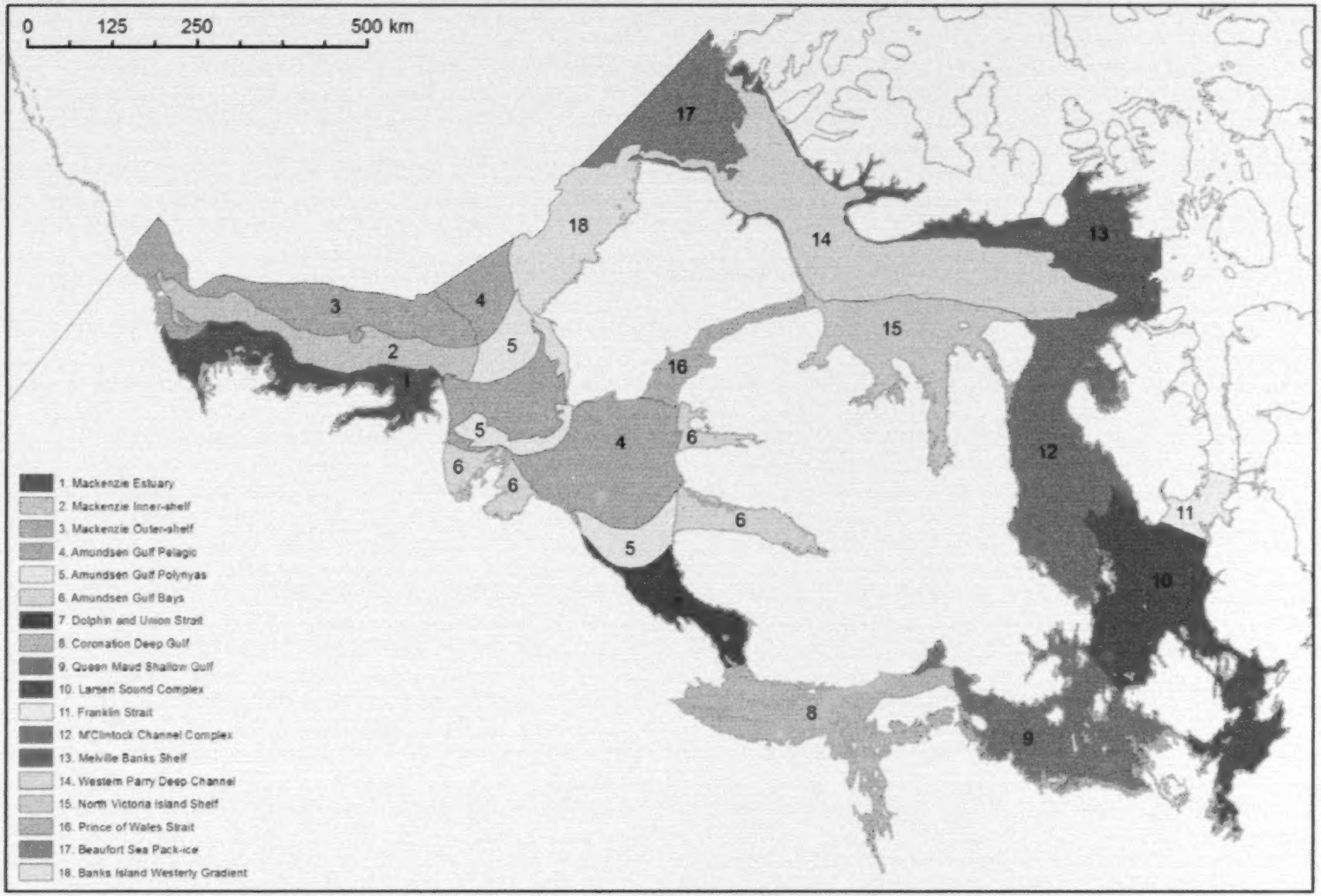

Figure 2. Eco-units identified in Canada's Western Arctic Bioregion (Hodgson et al. 2015).

Key to the development of Canada's MPAN are its commitments under the 1992 UN CDB (United Nations 1992, Article 8a) and subsequent decisions made by the Conference of the Parties to the CBD (e.g., UNEP 2008). In terms of dictating how MPAN areas will be selected, UNEP (2008) lays out the fundamental framework including five Required Network Properties and Components and four initial steps to be taken when planning an MPAN.

Network properties and components are;

1) Ecologically and biologically significant areas (EBSAs),
2) representativity[1],
3) connectivity[2],
4) replicated ecological features[3], and
5) adequate and viable sites[4].

Initial steps in development of MPAN areas;

1) scientific identification of EBSAs,
2) develop/choose a biogeographic, habitat, and/or community classification system,
3) use qualitative and/or quantitative techniques to identify potential areas of the MPAN, and
4) assess the adequacy and viability of selected sites.

Figure 3 identifies EBSAs developed in the WAB (Paulic et al. 2009, DFO 2011, DFO 2015). Hodgson et al. (2015) focused on Step 2 in the Development of MPAN areas and produced a spatial planning scheme made up of 18 eco-units (Figure 2) within the WAB. This paper focuses on Step 3 and will identify areas suitable for inclusion in the MPAN based on spatial analysis following protocols and guidelines laid out under the UN framework and DFO science advice. These areas will be called Priority Conservation Areas (PCA).

Areas of Interest (AOI) are the first step in the process to establish an MPA in Canada. The role of a PCA in MPAN planning is analogous to the role of AOI in establishing MPAs. The PCA delineates an area that meets the requirements necessary for delineation of an individual protected area while at the same time placing this area in perspective with the goals and requirements for a functional network of protected areas. The PCA however may be far from the final size, shape and location of a fully designated marine protected area and the type of protected area is also not fully defined (although it may be suggested) in the PCA stage. It is the intended role of each PCA, spatially as well as functionally, within the ecosystem that is most important. The intent behind each PCA is linked to the selection criteria and the overarching objective of the MPAN.

[1] Representativity is captured when the network consists of areas representing the different biogeographical subdivisions that reasonably reflect the full range of ecosystems, including the biotic and habitat diversity of those marine ecosystems (UNEP 2008).

[2] Connectivity in the design of a network allows for linkages whereby protected sites benefit from larval and/or species exchanges, and functional linkages from other network sites (UNEP 2008).

[3] More than one site contains examples of given species, habitats and ecological processes (i.e., features) that naturally occur in the given biogeographic area (UNEP 2008).

[4] Adequate and viable sites within a network have sufficient size and protection to ensure the ecological viability and integrity of the feature(s) for which they were selected (UNEP 2008).

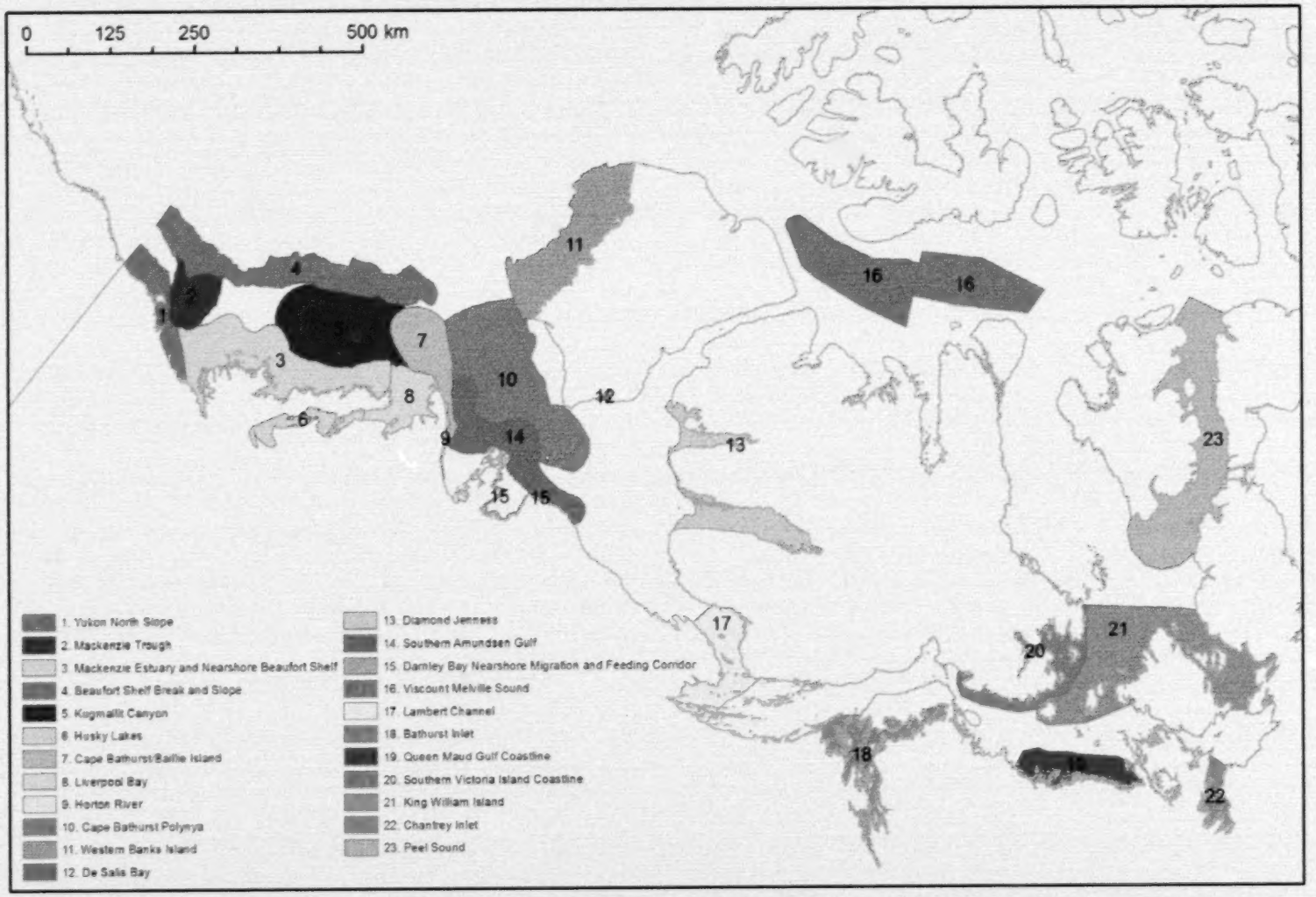
0 125 250 500 km
1. Yukon North Slope
2. Mackenzie Trough
3. Mackenzie Estuary and Nearshore Beaufort Shelf
4. Beaufort Shelf Break and Slope
5. Kugmallit Canyon
6. Husky Lakes
7. Cape Bathurst/Baillie Island
8. Liverpool Bay
9. Horton River
10. Cape Bathurst Polynya
11. Western Banks Island
12. De Salis Bay
13. Diamond Jenness
14. Southern Amundsen Gulf
15. Darnley Bay Nearshore Migration and Feeding Corridor
16. Viscount Melville Sound
17. Lambert Channel
18. Bathurst Inlet
19. Queen Maud Gulf Coastline
20. Southern Victoria Island Coastline
21. King William Island
22. Chantrey Inlet
23. Peel Sound

Figure 3. Ecologically and Biologically Significant Areas in the Western Arctic Bioregion (DFO 2011, DFO 2015). The black line denotes the boundary of the Western Arctic Bioregion. The two sections to the Viscount Melville Sound EBSA were identified at two different meetings and there was no attempt to align the boundaries.

CONSERVATION OBJECTIVE FOR MPAN-WAB

The main goals of marine projected area networks as stated in the UN CBD (Dec. IX/20) are to designate marine areas for enhanced management that;

a) are ecologically important or vulnerable and that as a whole work together to achieve a network that is representative of all physical ecological units (akin to habitat types),

b) foster connectivity between sites in terms of ecosystem function and management, and,

c) replicate ecologically important physical units and/or ecosystem processes.

Strategically, areas need not be representative of the 'best' habitat or most productive ecosystems; rather, areas are spatially situated such that enhanced management of these areas can lead to improved ecosystem resilience or improved management of the broader marine environment based on knowledge and/or processes specific to these areas. With this in mind, the conservation objective for the WAB-MPAN is:

> The Marine Protected Area Network is established to ensure as much as possible that ecosystems and ecosystem services of the Western Arctic Bioregion remain healthy and productive for future generations. This will be accomplished by enhanced management including ongoing knowledge acquisition such that all ecological diversity and ecologically significant areas are represented thereby providing better knowledge and adequate management options to deal with future changes and pressures. Explicitly this includes all four levels of diversity of the UN CBD.

It should be noted that;

1) the objective is to ***enhance*** the management of areas and resources not simply to preserve areas or remove areas from human activity or the effects of activities. Perceivably, enhanced management actions could involve the decision to introduce a specific activity to a designated area **IF** the result of this action could be shown to increase the resilience of the ecosystem,

2) areas should be chosen and designated in a way that increases the potential for future management options to be implemented, for example, this may include consideration of the type of conservation used (e.g., MPA or National Marine Conservation Area (NMCA)) as well as the conservation authority lead (e.g., DFO, Environment Canada, Aboriginal Affairs and Northern Development Canada, territorial government). MPAs and other conservation/protection areas should have their own conservation objective(s) that specifically outline the goals of the individual area without compromising the overall objectives of the network. Feasibility of evaluating whether the goals are met should be considered when they are established.

3) MPAN planning should consider alternative options to fixed designated conservation areas when possible. As many marine ecosystem characteristics (e.g. sea ice or water type) and species within these environments are highly changeable and/or mobile, conservation strategies should attempt to be adaptable to spatial and temporal changes. Within the defined national and international guidelines on MPANs, this issue is well noted, however to date no strategy has been accepted. Despite the lack of guidance on this matter and the obvious logistical difficulties in protecting an undefinable area, options need to be considered as the process to define PCAs and the overall MPAN continues beyond this initial preliminary identification of potential sites.

PCA DELINEATION ANALYSIS

The criteria used for area selection are to;

1) maximise representativity of eco-units within a manageable (number and size) set of areas,
2) include areas within identified EBSAs where possible,
3) capture eco-unit interfaces, where possible, to enable linkages and connectivity between ecosystems within the same area,
4) consider existing protected areas (by inclusion as-is and/or by expansion),

At this planning stage, the goal is that all PCAs proposed for the network represent the diversity of habitat types (eco-units) as well as special/unique areas (EBSAs). This is not the same as ultimately achieving a set of protected areas that are truly representative of species and specific habitat diversity. This latter representativity will require more information and will have to be considered once proposed PCAs are being developed into designated marine conservation or protected areas. The relative amount of representativity is dependent on the total percentage of area identified for conservation/protection in addition to capturing areas representative of EBSAs and eco-units. Since the current goal[5] based on UN CBD targets is set at 10% of all marine area, this was selected as the input criterion (as a guide, not a limitation) used to establish representativity. Achieving this target can be accomplished with a few or many selected areas, depending on the size of the areas. To establish input criteria for analysis, a theoretical optimal size of area is required. It is acknowledged that the final size and shape of an area requires further scientific input and analysis to maximize the potential of the selected area to contribute to the conservation objectives of the MPAN and individual area. Based on logistical considerations related to areas, management and monitoring, as well as evaluation of the current size of Canadian MPAs (current average MPA size = 1234 km^2 (official DFO MPAs), or 71 km^2 (all Canadian protected marine areas), 2,500 km^2 (equivalent of 50 km x 50 km) was used as the initial target size for a PCA. The Western Arctic Bioregion contains approximately 550,000 km^2 of marine area. Following Canada's international commitments to protect 10% of the marine environment, we used 55,000 km^2 as an output target for delineation of PCA. Based on the optimal PCA size, the WAB would require 22 PCAs (of average/optimal size) to achieve the target 10%. These input parameters served as a guide only and outputs were not restricted to these guideline parameters.

Maximum representativity is accomplished by locating PCAs such that as many replicate areas representing eco-units and EBSAs are captured as possible. This is accomplished by locating PCAs such that boundaries between eco-units and EBSAs are preferred during the selection analysis to capture multiple eco-units with one PCA. This strategy also leads to accomplishing criterion 3 of the analysis. In the case of eco-units, because they boarder one another to achieve full coverage of the bioregion, boundary areas would likely be less representative of the target features of the eco-unit than the centre. Since EBSAs have no requirement to cover the entire area of the bioregion, edge-effects would be reduced in comparison to eco-units.

[5] CBD Target 11: By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.

Potential 'edge-effects' should be considered in the final evaluation of PCAs. There could be a benefit in a conservation strategy to capture transition zones between eco-units.

EBSA-ECO-UNIT OVERLAY

UN CBD guidance states that PCAs will be derived directly from UNEP/CBD steps one (EBSAs) and step two (eco-units). Thus, the first step in the spatial analysis presented here is to find the intersection of EBSAs and Eco-units (Figure 4).

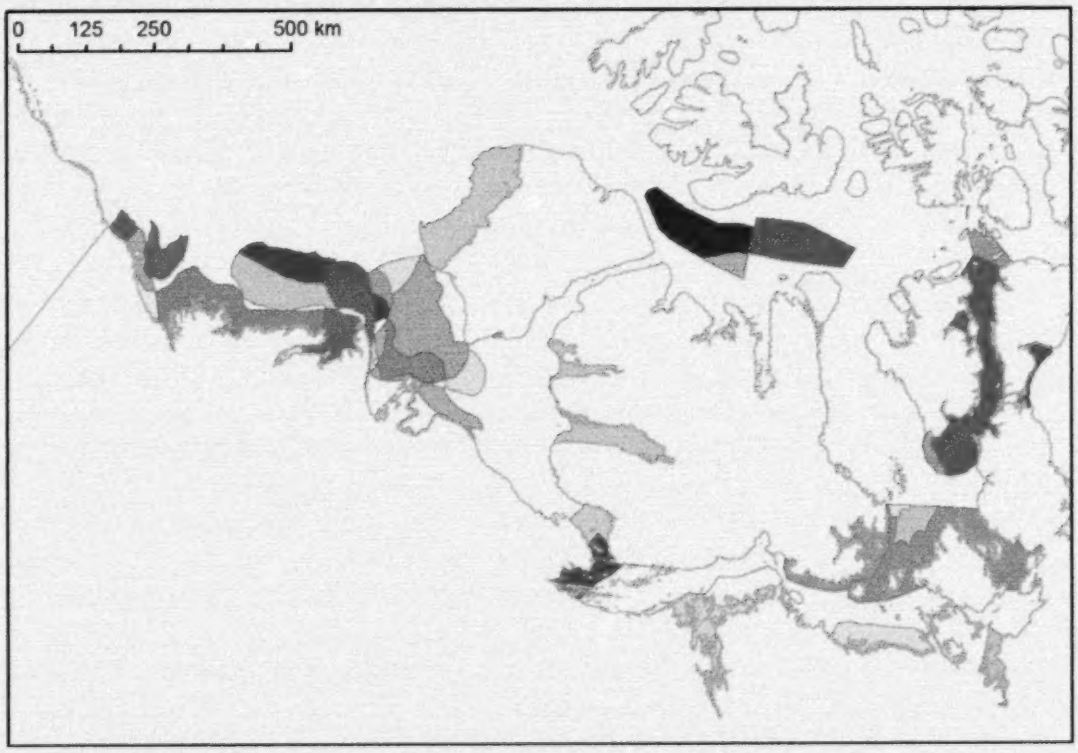

Figure 4. EBSA polygons from Figure 3 overlaid upon Figure 2 eco-unit polygons. All coloured areas are the overlap of EBSAs and eco-units. Non-coloured areas have none or one, but not both, EBSA or eco-unit.

The analysis of the intersection between eco-units and EBSAs created 46 areas of overlap. All eco-units have representative areas after the intersection with EBSAs (i.e., most eco-units are represented within EBSAs), except the Beaufort Sea Pack-ice, Melville Banks Shelf, and M'Clintock Channel Complex eco-units (Figure 5). Eco-units represented within EBSAs varies from 0% to 100% (Figure 5). This indicates that PCAs cannot achieve representativity of all eco-units by just following the general pattern of EBSAs. EBSAs will help greatly in some areas in determining representative PCAs, however, in many areas EBSAs will be of little or no help.

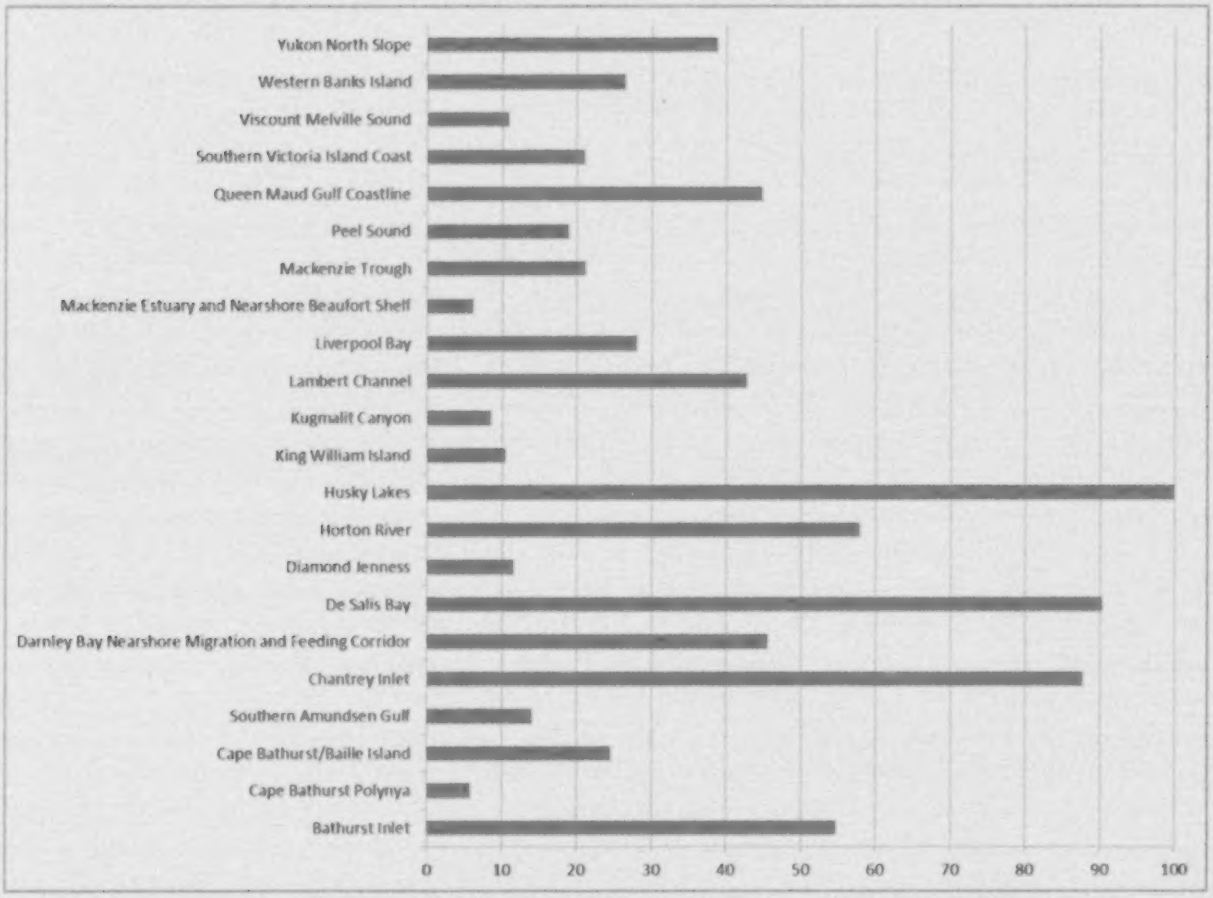

Figure 5. Percent area of eco-units represented within EBSAs (from Figure 4). For example, 61% of the Amundsen Gulf Polynyas eco-unit is represented by EBSAs.

REPRESENTATIVITY 'HOTSPOTS'

In order to evaluate potential PCA placement in terms of representativity of ecosystem diversity (by way of EBSA and eco-unit capture), a 'moving-window' analysis with an analysis 'window' size equal to that of the optimal PCA (50 x 50 km) was conducted (Figure 6). The moving window analysis tabulates, in a step-wise progression through the study area, the number of eco-units/EBSAs captured. Areas capturing multiple EBSAs/Eco-units are shown ranging from blue (low diversity) to red (high diversity). Areas capturing more eco-units/EBSAs are preferred for locating PCAs based on the principle of capturing areas of diverse habitat/ecosystem type. This does not necessarily capture areas that are the best individual area to represent a single ecosystem type. Focusing on areas best representing individual habitat types would likely require more PCAs equal to or greater than the combined number (41) of eco-units (18) and EBSAs (23). PCAs need to represent ecosystem diversity within the WAB.

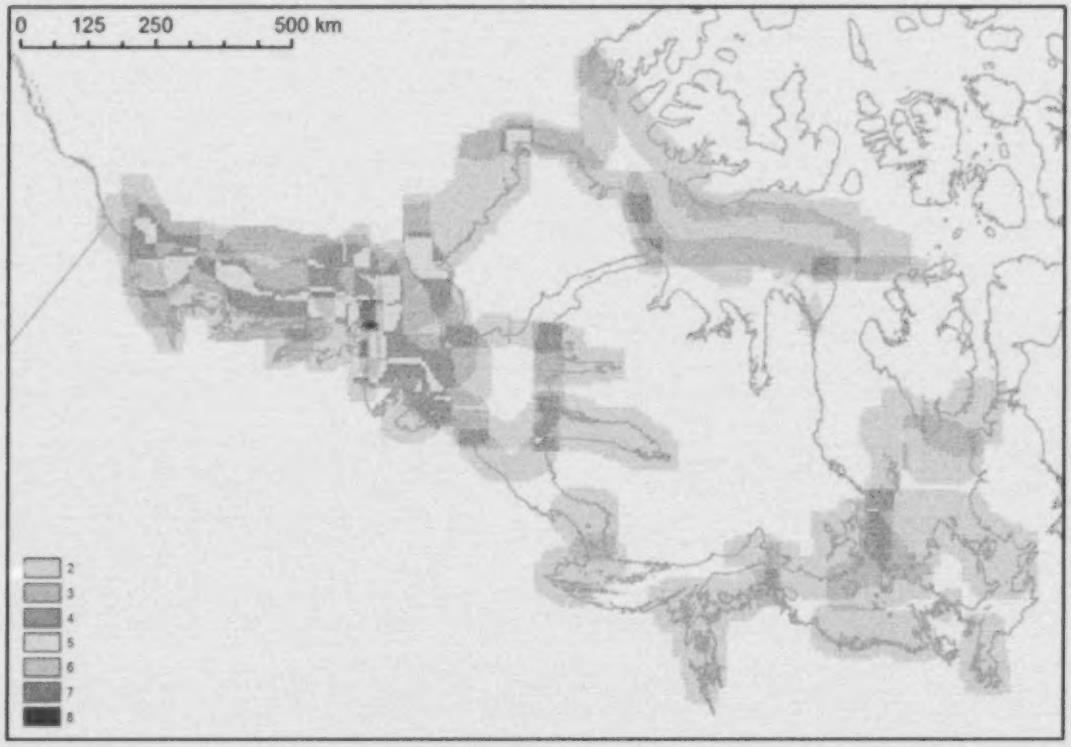

Figure 6. Results of 'moving window' analysis illustrating areas with potential for representing multiple EBSAs/eco-units (blue areas capturing 2, red areas capturing 8-red EBSAs and/or eco-units within a 2,500 km^2 area).Colourless areas do not capture multiple EBSAs/eco-units.

PCAs identified in the hotspot analysis focused on areas that would capture a minimum of four EBSAs and/or eco-units. These PCAs are (from west to east) Ivvavik National Park (expansion), Mackenzie offshore, Husky Lakes, Cape Bathurst, Banks Island Slope, Cape Prince Alfred, Ulukhaktok, De Salis Bay to Walker Bay, Byam Martin to Steffansson Island, Albert Edward (Figure 7).

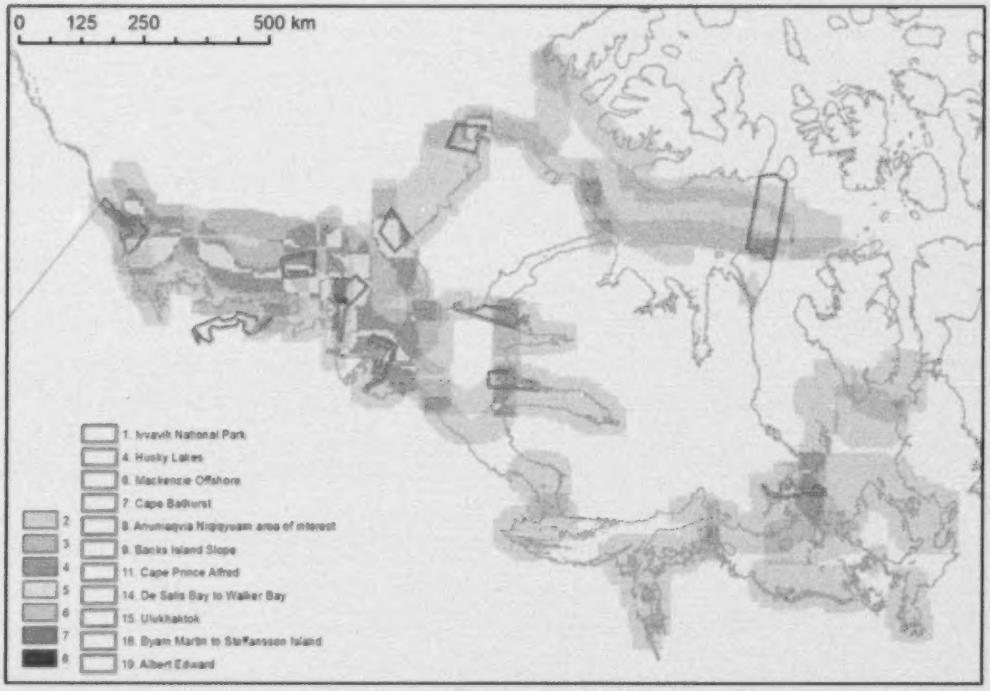

Figure 7. Proposed Priority Conservation Areas (red outlined areas) located to correspond with coloured areas representing multiple (two to eight) EBSAs and/or eco-units.

EXISTING AND EXPANSION OF CONSERVATION AREAS

One of the criteria used for PCA selection was to consider inclusion of existing protected areas as-is and/or by their expansion to capture PCAs. Several conservation areas are located in the WAB (Figure 8). The Tarium Niryutait Marine Protected Area (TNMPA) is currently the only official MPA in the WAB. The Anuniaqvia Niqiqyuam area of interest (ANAOI) is an area proposed for MPA designation. There are four Marine Bird Sanctuaries (MBS) with coverage in the marine environment including Kendal Island Bird Sanctuary, Anderson River Delta MBS, Banks Island #1 MBS and Queen Maud Gulf MBS. Of these, the Queen Maud Gulf MBS is the most significant in size, representing approximately 5,200 km^2 of marine area. There are also two National parks with coastal components, Ivvavik and Aulavik. There is also Tuktut Nogait National Park, but it does not have a coastal component.

One Nunavut Wildlife Area (Polar Bear Pass) and one Marine Bird Sanctuary (Banks Island #2 MBS), that currently include little or no marine components, are in strategic locations to add to the MPAN for the WAB. The extent of the proposed expansions for these two areas into marine areas was based on the optimal/average size of PCA discussed earlier.

All existing areas with a marine component and the two proposed expansion areas are included as potential PCAs (Figure 8). This includes, from west to east, Ivvavik, TNMPA, Kendal Island Bird Sanctuary, Anderson River Delta MBS, ANAOI, Banks Island #1 MBS, Aulavik, Queen Maud Gulf MBS, Graham Moore Bay (Polar Bear Pass).

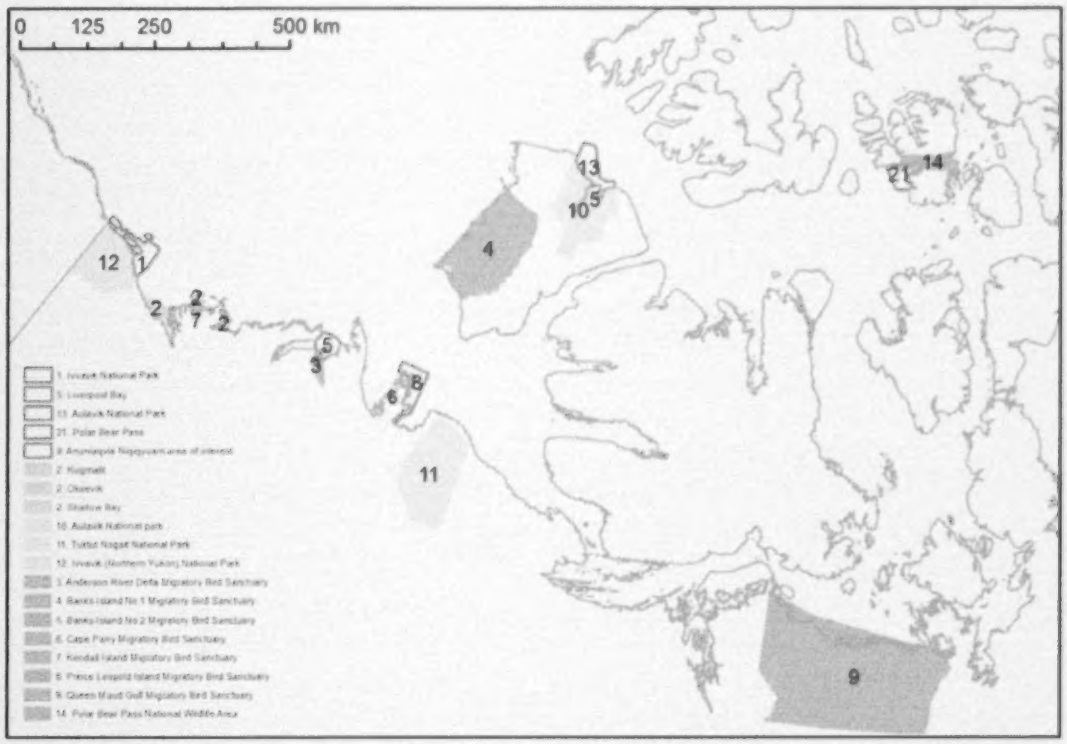

Figure 8. Existing Marine conservation areas (blue shading) and proposed areas (red outlines) including expansion of existing terrestrial conservation areas.

EBSA REPRESENTATIVITY

Thus far (including existing conservation areas, expanded conservation areas and hot spots) 18 PCA are identified. However, four EBSAs (Lambert Channel, Bathurst Inlet, Chantrey Inlet, Peel Sound) are not represented in the selection of these PCAs. As UN guidelines indicate that all EBSAs should be represented in the MPAN, locations of potential PCAs were evaluated in each of these EBSAs individually.

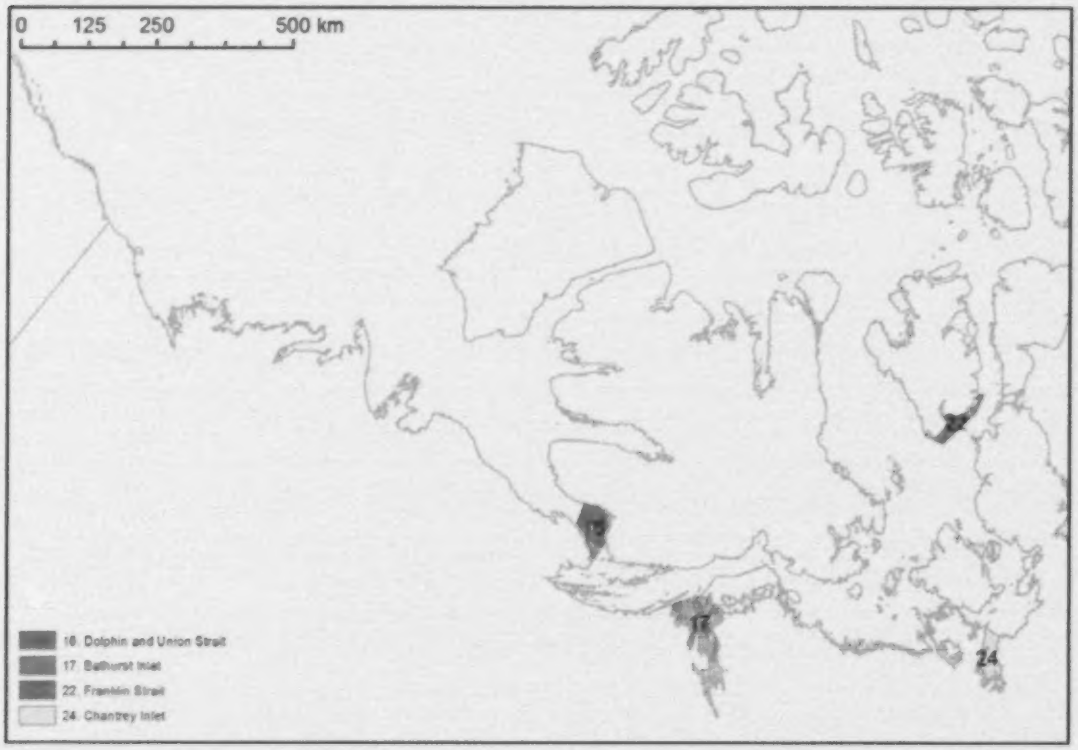

Figure 9. Proposed Priority Conservation Areas added to achieve representativity of EBSAs not captured in previous steps of this analysis.

Dolphin and Union Strait covers two eco-units and one EBSA. It was not initially identified as a PCA based on the moving window analysis (using a threshold cut-off of four captured input areas). However, one PCA is required to provide representativity of the Lambert Channel EBSA. This EBSA was identified in DFO (2011) as a polynya and estuary feature. The polynya was evident in the spring sea ice frequency analysis by mid-May (Hodgson et al. 2015), but was not deemed significant in size to justify classification as part of the Amundsen Polynya eco-unit. It likely results from higher currents through the channel that help breakup ice earlier than in the surrounding areas. This is in contrast to the larger scale forces causing the Amundsen Gulf polynyas. The area delineated (Figure 9) captures all factors including the area of most diversity (moving window analysis), representativity and is supported by community interest.

Chantrey Inlet (Figure 9) is located fully within the Queen Maud Shallow Gulf eco-unit and lies over 200 km from the next nearest eco-unit. The size of the entire inlet is approximately that of the target PCA, so it is being identified as a PCA.

Bathurst Inlet (Figure 9) lies within the Coronation Deep Gulf eco-unit. Thus far, the Coronation Gulf eco-unit has only one representative area derived from the hotspot analysis. A second PCA partially or wholly within the Coronation Deep Gulf eco-unit would be desirable to ensure adequate representativity. However, Bathurst Inlet is considerably larger than the target PCA therefore other factors are considered to narrow the area. The mouth of Bathurst Inlet, from Jameson Islands in the west, to and including Melville Sound and Elu Inlet in the east is identified as the best area for a PCA supported by historical Inuit resource use and potential for community support.

Franklin Strait is not only within an unrepresented EBSA it is also an unrepresented eco-unit. The boundary of the bioregion divides Franklin Strait from Peel Sound, and it may be that Peel Sound and Franklin Strait would have been part of the same eco-unit had they been within a single bioregion. During MPAN planning in the adjacent Eastern Arctic Bioregion, further PCAs may be identified in Peel Sound. But for now, given the small size of this eco-unit and the portion of the EBSA within the WAB, a single PCA achieves representativity (if not replication).

UNDER-REPRESENTED ECO-UNITS

The James Ross Strait PCA (Figure 10) is located within the King William Island EBSA, which thus far is only represented by the extension of Albert Edward PCA into Victoria Strait. As an alternative, further expansion of the Albert Edward PCA (an elimination of a James Ross PCA) would increase the weak representation of the King William EBSA, however, this would result in no replication (i.e., only a single representative PCA) within this EBSA. Traditional uses of the this region have been captured in the Inuit Land Use and Occupancy Report (1976) where the areas are identified as being important for whales, seals and polar bears (Freeman 1976).

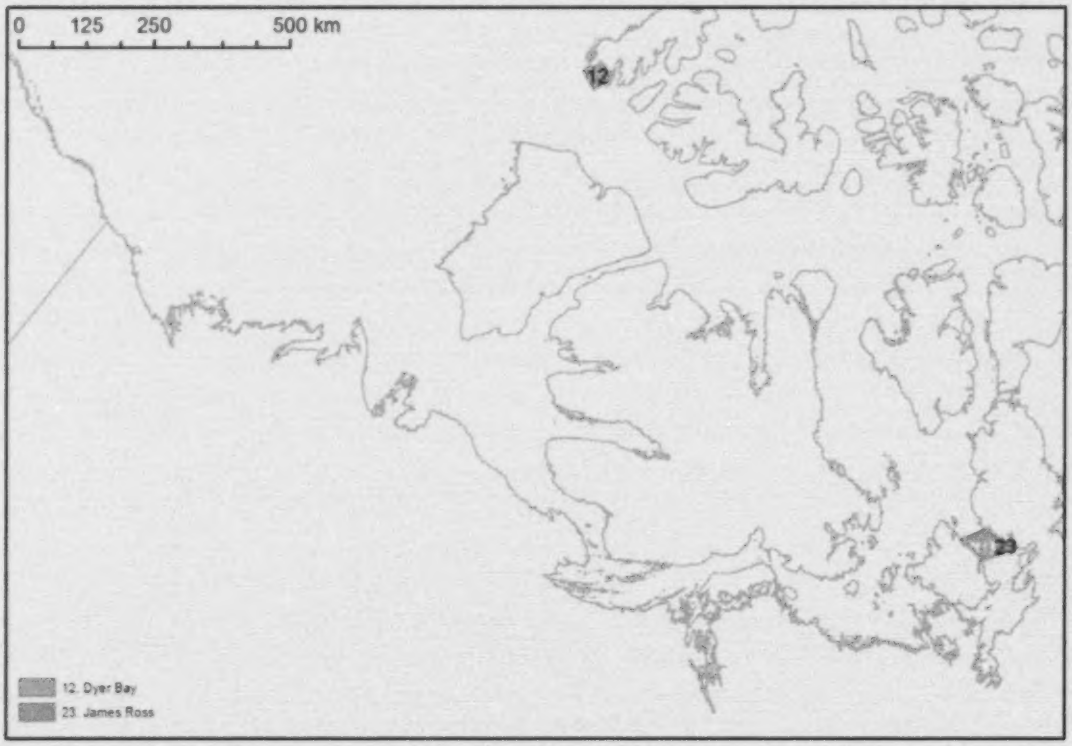

Figure 10. Proposed PCA in areas where eco-units were under-represented.

Dyer Bay PCA (Figure 14) is located at the intersection of three eco-units (Figure 2) and although this did not meet the requirements of PCA designation via the moving window analysis, these three eco-units are under-represented. Dyer Bay is the most northerly proposed PCA, and information regarding this area of the bioregion is limited. The purpose of this PCA is to ensure representativity of this remote area of the bioregion, however, further information and/or research is required to ensure location and size of this PCA is appropriate prior to consideration for formal protection of any kind.

PROPOSED PCAs

Figure 11 shows the 22 proposed PCAs in the WAB.

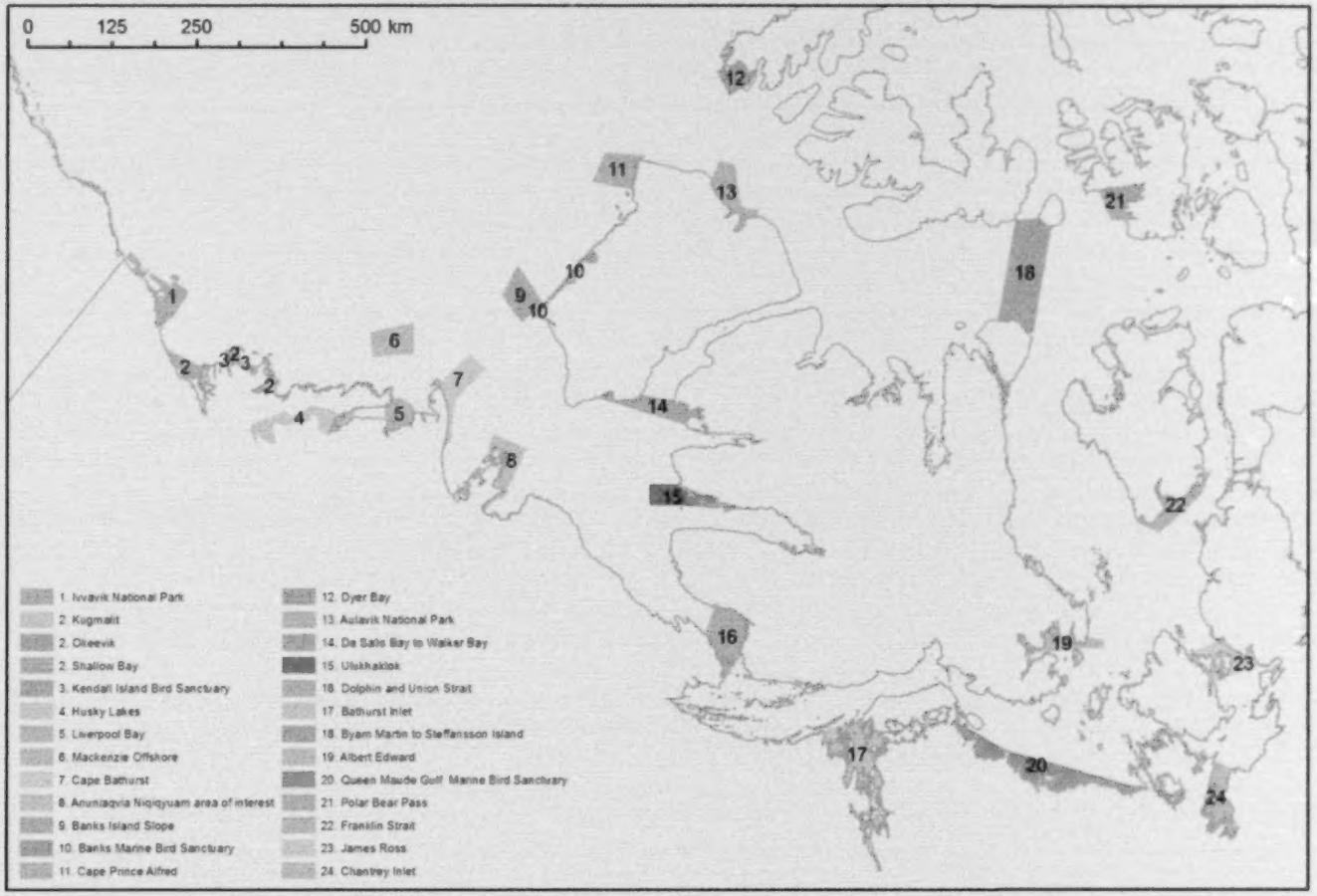

Figure 11. Final proposed PCA for the Western Arctic Bioregion.

REPRESENTATIVITY OF ECO-UNITS

In general the representation of eco-units within the proposed PCAs is good (Figure 12). On average, 13% of each eco-unit is represented within the PCAs (Standard Deviation (SD) 5.6) which is in line with goals based on UN commitments for proportions of protected marine area (10%). Representativity is quite variable. Five eco-units are under-represented or over-represented, based on representativity beyond one SD. Severely under-represented eco-units include Beaufort Sea Pack-ice (3.9%), and M'Clintock Channel Complex (0.7%), North Victoria Island Shelf (1.2%), and Prince of Wales Strait (4.4%). Over-represented eco-units (>20%) include Franklin Strait (31.0%) and Dolphin and Union Strait (28.9%) (Figure 12).

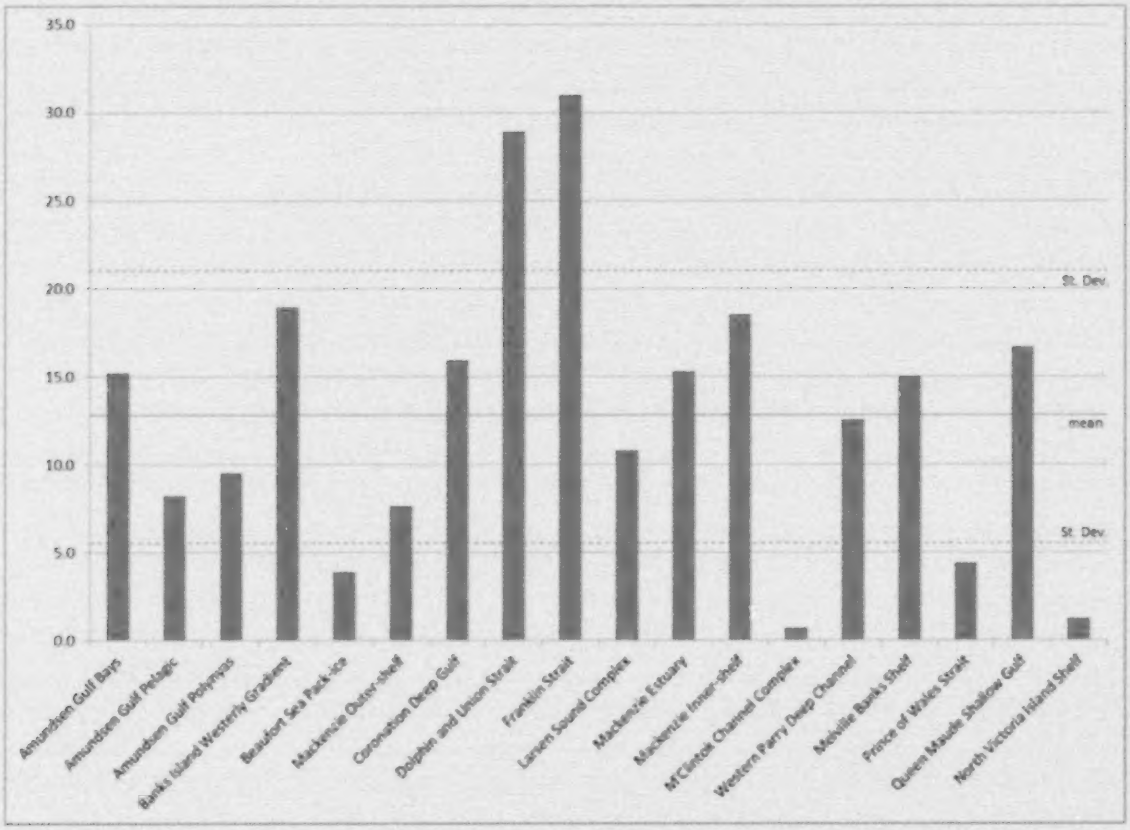

Figure 12. Percent area of respective Eco-units captured in proposed PCA including mean and standard deviation values.

Beaufort Sea Pack-ice and Franklin Strait have skewed representativity because these eco-units extend beyond the Bioregion boundaries. In the case of Beaufort Sea Pack-ice, later opportunities to increase representativity will come when planning PCA/MPAN into the Arctic Basin (or Arctic Archipelago).

The size of the Franklin Strait eco-unit is small relative to the size of the PCA. Peel Sound and Franklin Strait would likely have been identified as one eco-unit if the boundary between the Western Arctic and Eastern Arctic bioregions was at the north end of Peel Sound. Much of Franklin Strait and Peel Sound lies within the adjacent Eastern Arctic Bioregion. Future PCA delineation in the Eastern Arctic Bioregion portion of Franklin Strait/Peel Sound will likely be

minimal, thereby making the overall representativity (across bioregions) of this eco-unit in line with goals.

A large percentage of the area of the Queen Maude Gulf eco-unit is captured by the Queen Maude Gulf Marine Bird Sanctuary. This area is of also of importance to four communities in this eco-unit.

M'Clintock Channel Complex has low representativity. There are no EBSAs identified in this area and there are no nearby communities so there are limited data for this area. At this stage in the development of PCAs (toward MPAN) no further adjustments or refinements were made to address disproportionate representativity. Future refinement of the PCA and/or MPAN may consider opportunities to improve this imbalance.

REPRESENTATIVITY OF EBSAs

Average EBSA representativity by area is 35% which is a function solely of the size of EBSAs in relation to the goal of 10% of total marine area. Representativity is highly variable (± 1 SD) between 5 and 60% (Figure 13). Again this is a function of the non-standard size of EBSAs in contrast to that of eco-units. Despite the high variability, few EBSAs (Mackenzie Estuary, Kugmallit Canyon, and Bathurst Polynya) are under-represented (under 10%). These EBSAs are some of the largest being between 6 and 10 times the size of the optimal PCA which can explain somewhat the low percent representativity. Many more EBSAs are highly represented (i.e., over 40%) including Lambert Channel, Chantrey Inlet, Queen Maud Gulf, Yukon Slope, De Salis Bay, Darnley Bay, and Horton River. Similarly, these highly represented areas can be explained by the fact they are small EBSA areas, between 1/10 and 4 times the optimal PCA size. Overall, representativity of EBSAs within the proposed network of PCA is good, on average 2,069 km^2 or 82% of the target PCA size, with smaller EBSAs having a much higher number of representative areas within PCAs.

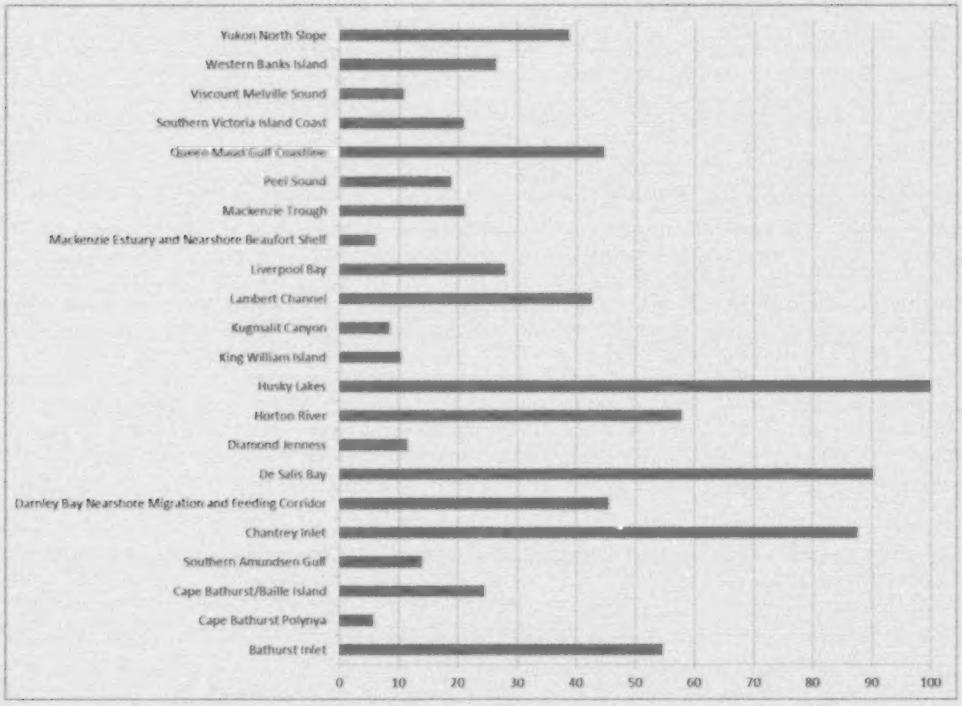

Figure 13. Percentage of EBSAs captured in proposed PCAs.

REGIONAL CONTEXT

PCA delineation is based on the scientific inputs used (i.e., eco-units and EBSAs) as well as the analysis described in previous sections of this paper. However, placing the proposed PCAs in context with other regional factors is important for the next steps in MPAN development. In addition, some of the contextual information available from communities can help to shed light on data-limited areas.

ECONOMIC ACTIVITIES

Establishing a PCA, MPA or any other area for the purpose of conservation in an area that overlaps with existing economic activities would be challenging. With this in mind, existing off-shore oil and gas rights areas are identified where they overlap with potential PCAs (Appendix 2). Two areas of overlap with existing leases occurred, in the Ivvavik and Banks Slope PCA. (see solid red areas in Figure A2).

COMMUNITY CONCORDANCE

Community support is essential for success of a protected areas strategy for the Arctic for two fundamental reasons;

1) the majority of the Canadian Arctic is part of comprehensive land claim agreements (e.g., Inuvialuit Final Agreement, Nunavut Land Claims Agreement), and
2) management and monitoring of these remote areas will require the aid and support of local people and authorities, and their knowledge base.

Previously designated MPAs such as TNMPA have engaged communities in the planning processes, including where and how to protect marine areas. Consultations with local people, other stakeholders and authorities will occur during the MPAN planning process. Areas of value to six communities in the Inuvialuit Settlement Region, Aklavik, Inuvik, Tuktoyaktuk, Paulatuk, Sachs Harbour, Ulukhaktok, are identified in Community Conservation Plans (Figure 14).

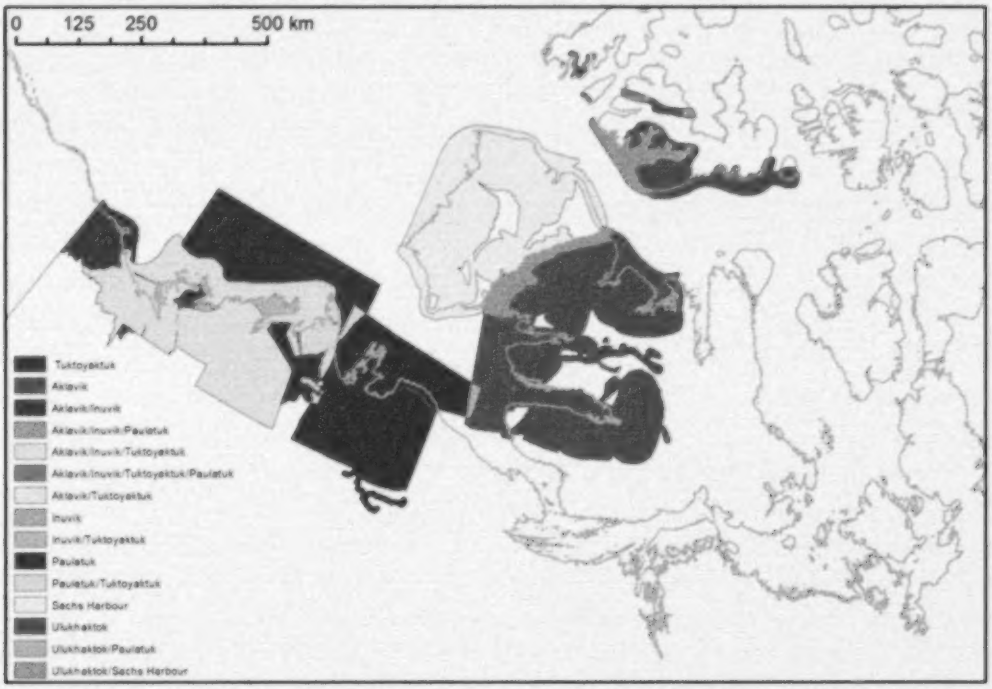

Figure 14. Areas used by the community as identified in Community Conservation Plans within the Inuvialuit Settlement Region.

The remaining communities in the WAB are located in the Kitikmeot Region of Nunavut and include Hamlets of Kugluktuk, Cambridge Bay, Gjoa Haven and Taloyoak and communities of Umingmaktok and Bathurst Inlet (both located on Bathurst Inlet). Traditional uses of the areas surrounding the permanent settlements of this region have been captured in the Inuit Land Use and Occupancy Report (Freeman 1976), the Northern Land Use Information Series (1977-1983), and more recently in the Nunavut Coastal Resource Inventory for Kugluktuk in 2009 (NCRI 2010) and Gjoa Haven in 2012 (NCRI 2012). A coastal resource inventory for Taloyoak is scheduled for 2014. The information from Freeman (1976) was used to identify areas of traditional use for harvesting of multiple species (fish, seals, whales, polar bears and waterfowl) in the areas offshore surrounding the Nunavut communities (Figure 15) reflecting areas valued by these communities. Figure 16 overlays the proposed PCAs with the areas of value to communities.

Resource use around Bathurst Inlet illustrates the importance of seals throughout, isolated patches of fish around Umingmaktok and north of the Bathurst Inlet settlement along with waterfowl. The west side of Bathurst Inlet has potential for a strong terrestrial connection and therefore may be a good option for a terrestrial/marine park situation. The east side has Umingmaktok which during the last census did have a few families making a permanent home. As well, the eastern side, particularly Melville Sound and Elu Inlet show significant multi-use of the marine areas for seals, polar bear, fishing, and waterfowl by people from Cambridge Bay.

From a marine perspective, areas associated with Kugluktuk include Simpson Bay - a multi-use area, including seals, polar bear, waterfowl, whales and isolated patches of fishing. This is also fitting with the hotspot analysis (Figure 6).

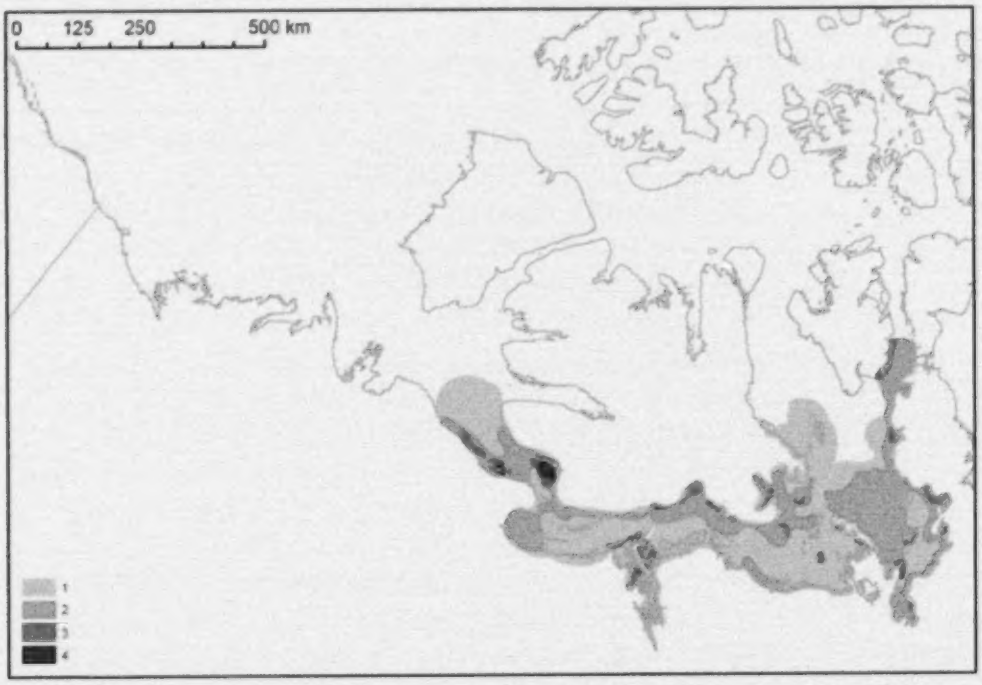

Figure 15. Areas of importance identified by communities during the Inuit Land Use and Occupancy Study. Use classes signify the number of wildlife types (fish, seals, whales, polar bears, waterfowl) found within an area (Freeman 1976).

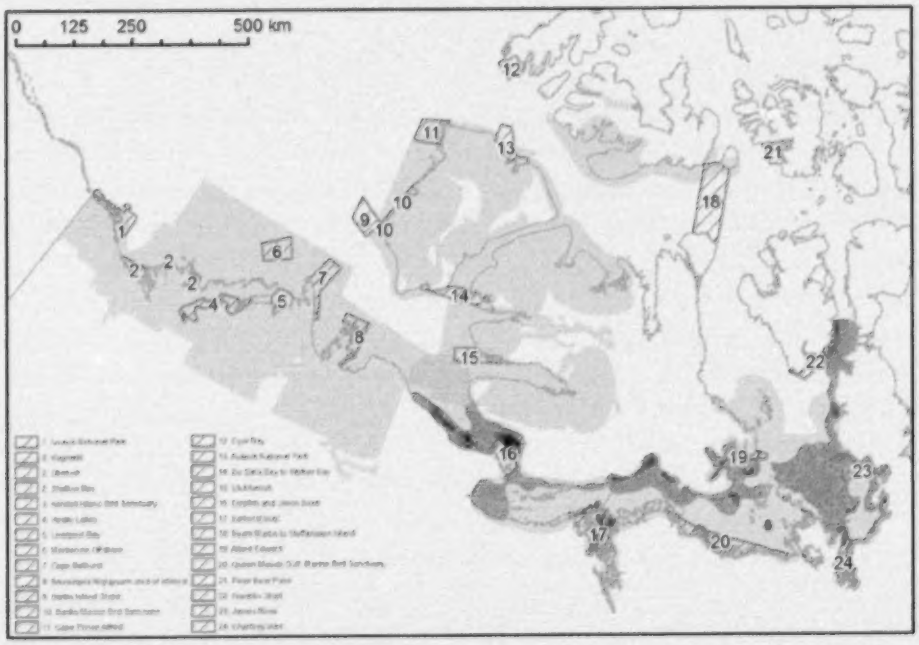

Figure 16. All proposed PCAs overlaying areas of community importance (from Figures 14 and 15).

Cambridge Bay residents extensively use marine resources; however, the largest multi-use marine area is centred around Albert Edward Bay where use of fish, seals, polar bear, and waterfowl are all identified. This area also aligns with the hotspot analysis (Figure 6).

Gjoa Haven residents indicated the largest areas of marine multi-use within Chantrey Inlet. Chantrey Inlet is an EBSA and therefore the most applicable place for a PCA in this region. Uses included fishing, seals, and waterfowl. Chantrey Inlet was also identified as a use area by Inuit from Baker Lake, Rankin Inlet and even as far away as Whale Cove.

Taloyoak residents utilized large areas outside the WAB, but within the WAB areas with the largest extent of marine multi-use included Spence Bay across James Ross Straight to King William Island and north to Kent Bay. Biota used included whales, seals and polar bear. Also areas north to Franklin Strait and Peel Sound where also identified for utilization of seals, whales and Polar bear. Given the overlapping utilization of James Ross Straight around Matty Island by people from Gjoa Haven and Taloyoak, this area is identified for a PCA. Even though this area is fully within the Queen Maud Gulf eco-unit (which has several representative PCA areas already), it is representative of the King William Island EBSA which thus far has only partial representation in the Albert Edward Bay PCA.

CONCLUSIONS

PCA DELINEATION RATIONALE AND SUMMARY

Twenty three (23) PCA have been identified through this study including the TNMPA. Rationales for PCA delineation are summarized in Table 1. EBSAs and eco-units represented in the PCA are listed as well as the primary criteria used for delineation. Criteria may be applicable to PCA but not shown in the table so as to distinguish between criteria used for PCA delineation and those criteria matches that were less relevant to delineation. For example, all PCA are important for their contribution to overall representativity, however, representativity was only used as a primary delineation criterion when an EBSA and/or eco-unit required placement of a PCA in order to achieve a minimum level of representativity. This process to delineate PCAs has achieved full representativity of all EBSAs and eco-units within the WAB based on the target percent-area of 10% total marine area. Most eco-units are represented in more than one PCA except Dolphin and Union, Franklin Strait, M'Clintock, Prince of Wales Strait, and Viscount Ice Pack. Many EBSAs are also represented in more than one PCA.

Table 1. Components for the proposed Priority Conservation Areas (PCAs) in the Western Arctic Bioregion. Initial PCAs were placed to overlap with at least four EBSAs and/or eco-units. Existing conservation areas were included as PCAs, some as is, and some with expansion proposed into marine areas. The remainder of PCAs were chosen to add representation of EBSAs or eco-units.

PCA number	Location	EBSAs	Eco-units	Existing or proposed conservation area
1	Ivvavik National Park	Yukon North Slope Mackenzie Trough	Mackenzie Estuary Mackenzie Inner-shelf Mackenzie Outer-shelf	✓ Expansion proposed

PCA number	Location	EBSAs	Eco-units	Existing or proposed conservation area
2	Tarium Niryutait Marine Protected Area [Shallow Bay, Okeevik, Kugmallit]	Mackenzie Estuary and Nearshore Beaufort Shelf	Mackenzie Estuary	✓
3	Kendall Island Bird Sanctuary	Mackenzie Estuary and Nearshore Beaufort Shelf	Mackenzie Estuary	✓
4	Husky Lakes	Husky Lakes	Mackenzie Estuary	✓
5	Liverpool Bay	Liverpool Bay	Mackenzie Estuary	✓ Expansion proposed
6	Mackenzie Offshore	Kugmallit Canyon Cape Bathurst / Baillie Island	Mackenzie Outer-shelf Mackenzie Inner-shelf	
7	Cape Bathurst	Cape Bathurst / Baillie Island Horton River Southern Amundsen Gulf Cape Bathurst Polynya Liverpool Bay	Amundsen Gulf Polynyas Amundsen Gulf Pelagic Mackenzie Inner-shelf Mackenzie Estuary	
8	Anuniaqvia Niqiqyuam area of interest	Southern Amundsen Gulf Darnley Bay Nearshore Migration and Feeding Corridor	Amundsen Gulf Bays Amundsen Gulf Polynyas Amundsen Gulf Pelagic	✓
9	Banks Island Slope	Western Banks Island	Banks Island Westerly Gradient Amundsen Gulf Polynyas Amundsen Gulf Pelagic	
10	Banks Marine Bird Sanctuary	Western Banks Island	Banks Island Westerly Gradient	✓

PCA number	Location	EBSAs	Eco-units	Existing or proposed conservation area
11	Cape Prince Alfred	Western Banks Island	Banks Island Westerly Gradient Beaufort Sea Pack-ice Melville Banks Shelf Western Parry Deep Channel	
12	Dyer Bay		Beaufort Sea Pack-ice Melville Banks Shelf Western Parry Deep Channel	
13	Aulavik National Park		Melville Banks Shelf Western Parry Deep Channel Beaufort Sea Pack-ice	✓ Expansion proposed
14	De Salis Bay to Walker Bay	De Salis Bay Diamond Jenness	Amundsen Gulf Bays Amundsen Gulf Pelagic Prince of Wales Strait	
15	Ulukhaktok	Diamond Jenness	Amundsen Gulf Bays Amundsen Gulf Pelagic Amundsen Gulf Polynyas	
16	Dolphin and Union Strait	Lambert Channel	Dolphin and Union Strait Coronation Deep Gulf	
17	Bathurst Inlet	Bathurst Inlet	Coronation Deep Gulf	
18	Byam Martin to Steffansson Island	Viscount Melville Sound	Melville Banks Shelf Western Parry Deep Channel M'Clintock Channel Complex North Victoria Island Shelf	
19	Albert Edward	Southern Victoria Island Coastline King William Island	Queen Maud Shallow Gulf Larsen Sound Complex	
20	Queen Maude Gulf Marine Bird Sanctuary	Queen Maud Gulf Coastline	Queen Maud Shallow Gulf	✓
21	Polar Bear Pass		Melville Banks Shelf	✓ Expansion proposed

PCA number	Location	EBSAs	Eco-units	Existing or proposed conservation area
22	Franklin Strait	Peel Sound	Franklin Strait Larsen Sound Complex	
23	James Ross	Kind William Island	Larsen Sound Complex	
24	Chantrey Inlet	Chantrey Inlet	Larsen Sound Complex	

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APPENDIX 1. PLACE NAMES

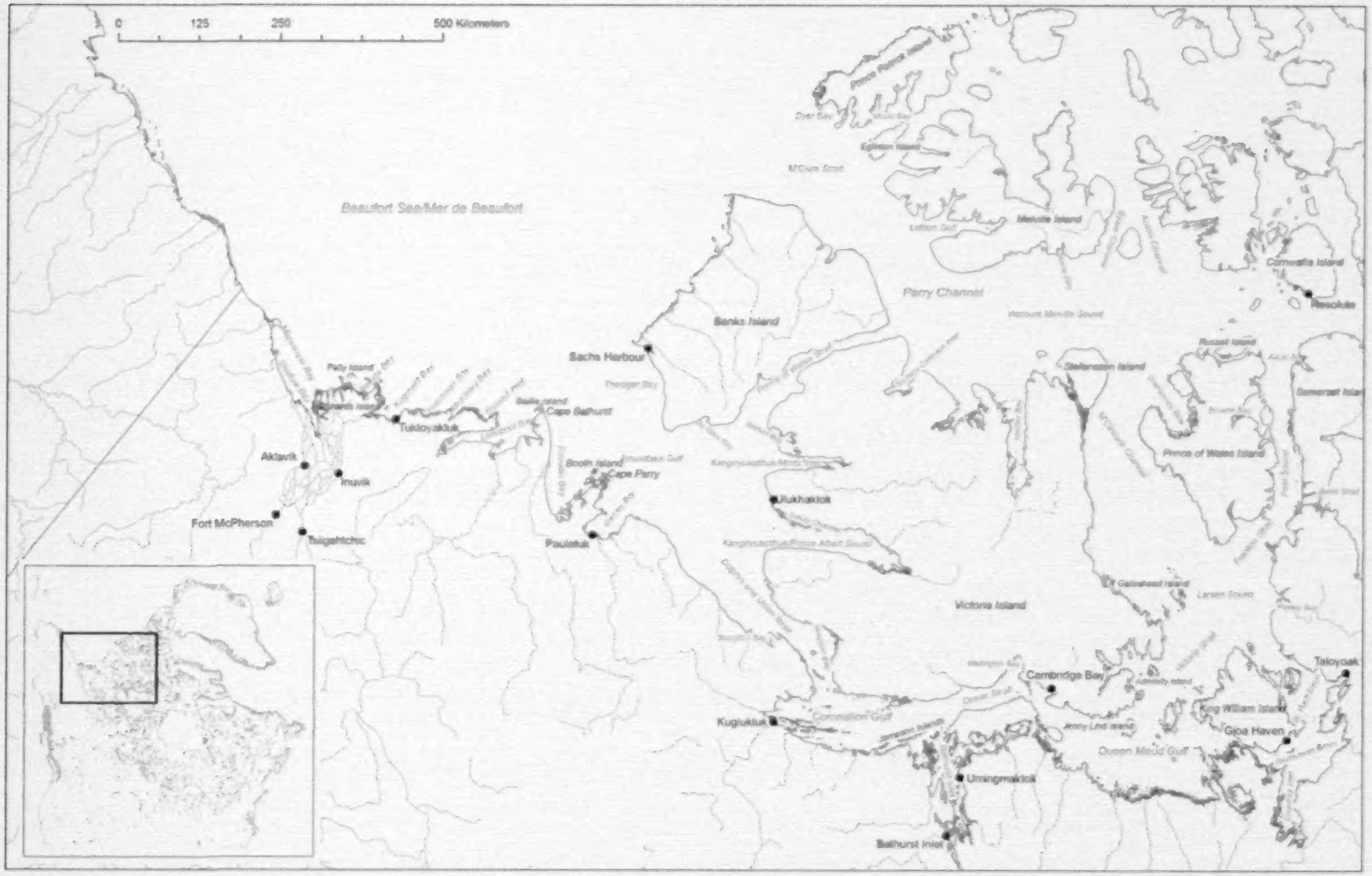

Figure A1. Place names in the Western Arctic Bioregion.

APPENDIX 2. OIL AND GAS LEASES

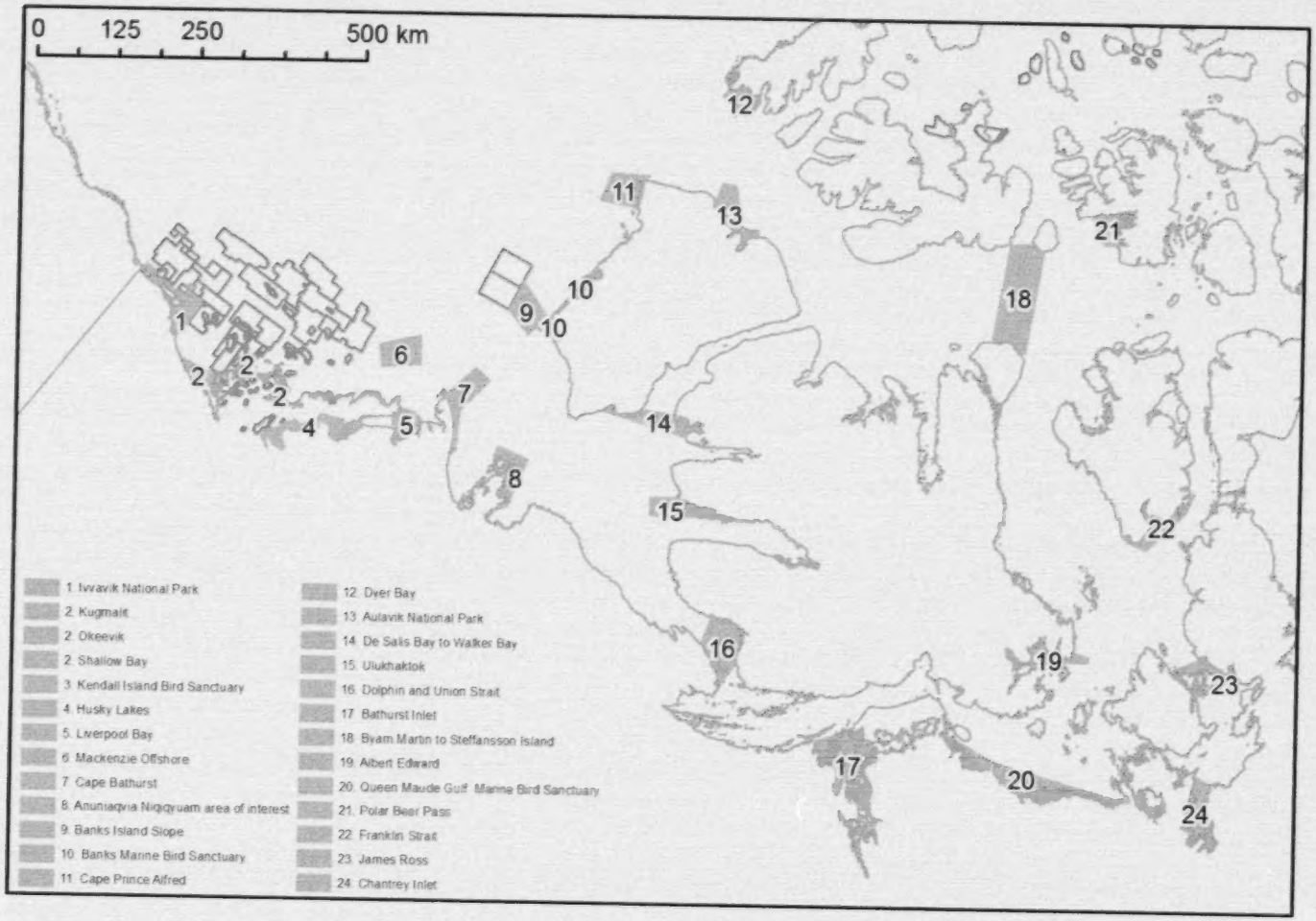

Figure A2. Overlapping existing Oil and Gas Rights with areas of potential PCA.